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Constraints on anomalous Higgs boson couplings using production and decay information in the four-lepton final state (Article) (Open Access)

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Abstract

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A search is performed for anomalous interactions of the recently discovered Higgs boson using matrix element techniques with the information from its decay to four leptons and from associated Higgs boson production with two quark jets in either vector boson fusion or associated production with a vector boson. The data were recorded by the CMS experiment at the LHC at a center-of-mass energy of 13TeV and correspond to an integrated luminosity of 38.6fb^{-1}. They are combined with the data collected at center-of-mass energies of 7 and 8TeV, corresponding to integrated luminosities of 5.1 and 19.7fb^{-1}, respectively. All observations are consistent with the expectations for the standard model Higgs boson. © 2017 The Author

Author keywords

Anomalous coupling Exotic spin Higgs

Funding details

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	Agentschap voor Innovatie door Wetenschap en Technologie	IWT	See opportunities by IWT
	Ministerstvo Školství, Mládeže a Tělovýchovy	MŠMT	See opportunities by MŠMT
	General Secretariat for Research and Technology	GSRT	See opportunities by GSRT

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References (58)

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1 Aad, G., Abajyan, T., Abbott, B., Abdallah, J., Abdel Khalek, S., Abdelalim, A.A., Abdinov, O., (...), Zwalinski, L.

Observation of a new particle in the search for the Standard Model Higgs boson with the ATLAS detector at the LHC

(2012) *Physics Letters, Section B: Nuclear, Elementary Particle and High-Energy Physics*, 716 (1), pp. 1-29. Cited 3931 times.
http://www.sciencedirect.com/science/journal/03702693
doi: 10.1016/j.physletb.2012.08.020

View at Publisher

2 Chatrchyan, S., Khachatryan, V., Sirunyan, A.M., Tumasyan, A., Adam, W., Aguilo, E., Bergauer, T., (...), Wenman, D.

Observation of a new boson at a mass of 125 GeV with the CMS experiment at the LHC

(2012) *Physics Letters, Section B: Nuclear, Elementary Particle and High-Energy Physics*, 716 (1), pp. 30-61. Cited 4166 times.
http://www.sciencedirect.com/science/journal/03702693
doi: 10.1016/j.physletb.2012.08.021

View at Publisher

3 Chatrchyan, S., Khachatryan, V., Sirunyan, A.M., Tumasyan, A., Adam, W., Bergauer, T., Dragicevic, M., (...), Swanson, J.
Observation of a new boson with mass near 125 GeV in pp collisions at √=7 and 8 TeV

(2013) *Journal of High Energy Physics*, 2013 (6), art. no. 081. Cited 217 times.
doi: 10.1007/JHEP06(2013)081

View at Publisher

4 Glashow, S.L.
Partial-symmetries of weak interactions

(1961) *Nuclear Physics*, 22 (4), pp. 579-588. Cited 2745 times.
doi: 10.1016/0029-5582(61)90469-2

View at Publisher

5 Englert, F., Brout, R.
Broken symmetry and the mass of gauge vector mesons

(1964) *Physical Review Letters*, 13 (9), pp. 321-323. Cited 1904 times.
doi: 10.1103/PhysRevLett.13.321

View at Publisher

6 Higgs, P.W.
Broken symmetries, massless particlees and gauge fields

(1964) *Physics Letters*, 12 (2), pp. 132-133. Cited 1874 times.

View at Publisher

7 Higgs, P.W.
Broken symmetries and the masses of gauge bosons

(1964) *Physical Review Letters*, 13 (16), pp. 508-509. Cited 1905 times.
doi: 10.1103/PhysRevLett.13.508

View at Publisher

8 Guralnik, G.S., Hagen, C.R., Kibble, T.W.B.
Global conservation laws and massless particles

(1964) *Physical Review Letters*, 13 (20), pp. 585-587. Cited 1452 times.
doi: 10.1103/PhysRevLett.13.585

View at Publisher

9 Weinberg, S.
A model of leptons

(1967) *Physical Review Letters*, 19 (21), pp. 1264-1266. Cited 5199 times.
doi: 10.1103/PhysRevLett.19.1264

View at Publisher

10 Salam, A.
Weak and electromagnetic interactions
(1968) *Elementary Particle Physics: Relativistic Groups and Analyticity, Proceedings of the Eighth Nobel Symposium*, p. 367. Cited 1044 times.
N. Svartholm Almqvist & Wiksell Stockholm

11 Chatrchyan, S., Khachatryan, V., Sirunyan, A.M., Tumasyan, A., Adam, W., Aguilo, E., Bergauer, T., (...), Swanson, J.

Study of the mass and spin-parity of the Higgs boson candidate via its decays to Z boson pairs

(2013) *Physical Review Letters*, 110 (8), art. no. 081803. Cited 208 times.
http://oai.aps.org/filefetch?identifier=10.1103/PhysRevLett.110.081803&component=fulltext&description=markup&format=xml
doi: 10.1103/PhysRevLett.110.081803

View at Publisher

12 Chatrchyan, S., Khachatryan, V., Sirunyan, A.M., Tumasyan, A., Adam, W., Bergauer, T., Dragicevic, M., (...), Smith, W.H.

Measurement of the properties of a Higgs boson in the four-lepton final state

(2014) *Physical Review D - Particles, Fields, Gravitation and Cosmology*, 89 (9), art. no. 092007. Cited 207 times.
http://harvest.aps.org/bagit/articles/10.1103/PhysRevD.89.092007/apsxml
doi: 10.1103/PhysRevD.89.092007

View at Publisher

13 Khachatryan, V., Sirunyan, A.M., Tumasyan, A., Adam, W., Bergauer, T., Dragicevic, M., Erö, J., (...), Woods, N.

Constraints on the spin-parity and anomalous HVV couplings of the Higgs boson in proton collisions at 7 and 8 TeV

(2015) *Physical Review D - Particles, Fields, Gravitation and Cosmology*, 92 (1), art. no. 012004. Cited 80 times.
http://harvest.aps.org/bagit/articles/10.1103/PhysRevD.92.012004/apsxml
doi: 10.1103/PhysRevD.92.012004

View at Publisher

14 Khachatryan, V., Sirunyan, A.M., Tumasyan, A., Adam, W., Asilar, E., Bergauer, T., Brandstetter, J., (...), Woods, N.

Combined search for anomalous pseudoscalar HVV couplings in VH(H→bb¯) production and Hï¿½→ï¿½VV decay

(2016) *Physics Letters, Section B: Nuclear, Elementary Particle and High-Energy Physics*, 759, pp. 672-696. Cited 7 times.
http://www.sciencedirect.com/science/journal/03702693
doi: 10.1016/j.physletb.2016.06.004

View at Publisher

15 Khachatryan, V., Sirunyan, A.M., Tumasyan, A., Adam, W., Asilar, E., Bergauer, T., Brandstetter, J., (...), Woods, N.

Limits on the Higgs boson lifetime and width from its decay to four charged leptons

(2015) *Physical Review D - Particles, Fields, Gravitation and Cosmology*, 92 (7). Cited 12 times.
http://harvest.aps.org/bagit/articles/10.1103/PhysRevD.92.072010/apsxml
doi: 10.1103/PhysRevD.92.072010

View at Publisher

16 Aad, G., Abajyan, T., Abbott, B., Abdallah, J., AbdelKhalek, S., Abdinov, O., Aben, R., (...), Zwalinski, L.

Evidence for the spin-0 nature of the Higgs boson using ATLAS data

(2013) *Physics Letters, Section B: Nuclear, Elementary Particle and High-Energy Physics*, 726 (1-3), pp. 120-144. Cited 257 times.
doi: 10.1016/j.physletb.2013.08.026

View at Publisher

17 Aad, G., Abbott, B., Abdallah, J., Abdinov, O., Aben, R., Abolins, M., Abouzeid, O.S., (...), Zwalinski, L.

Study of the spin and parity of the Higgs boson in Diboson decays with the ATLAS detector

(2015) *European Physical Journal C*, 75 (10), art. no. 476. Cited 48 times.
http://link.springer-ny.com/link/service/journals/10052/index.htm
doi: 10.1140/epjc/s10052-015-3685-1

View at Publisher

18 Aad, G., Abbott, B., Abdinov, O., Abdallah, J., Abeloos, B., Aben, R., Abolins, M., (...), ATLAS Collaboration

Test of CP invariance in vector-boson fusion production of the Higgs boson using the Optimal Observable method in the ditau decay channel with the ATLAS detector

(2016) *European Physical Journal C*, 76 (12), art. no. 658. Cited 5 times.
http://link.springer-ny.com/link/service/journals/10052/index.htm
doi: 10.1140/epjc/s10052-016-4499-5

View at Publisher

19 Nelson, C.A.

Correlation between decay planes in Higgs-boson decays into a W pair (into a Z pair)

(1988) *Physical Review D*, 37 (5), pp. 1220-1225. Cited 59 times.
doi: 10.1103/PhysRevD.37.1220

View at Publisher

20 Soni, A., Xu, R.M.

Probing CP violation via Higgs boson decays to four leptons

(1993) *Physical Review D*, 48 (11), pp. 5259-5263. Cited 53 times.
doi: 10.1103/PhysRevD.48.5259

View at Publisher

21 Plehn, T., Rainwater, D., Zeppenfeld, D.

Determining the structure of Higgs couplings at the CERN large Hadron collider

(2002) *Physical Review Letters*, 88 (5), pp. 518011-518014. Cited 192 times.

View at Publisher

22 Choi, S.Y., Miller, D.J., Mühlleitner, M.M., Zerwas, P.M.

Identifying the Higgs spin and parity in decays to Z pairs

(2003) *Physics Letters, Section B: Nuclear, Elementary Particle and High-Energy Physics*, 553 (1-2), pp. 61-71. Cited 157 times.
http://www.sciencedirect.com/science/journal/03702693
doi: 10.1016/S0370-2693(02)03191-X

View at Publisher

23 Buszello, C.P., Fleck, I., Marquard, P., Van Der Bij, J.J.

Prospective analysis of spin- and CP-sensitive variables in $H \to ZZ \to l_1^+ l_1^- l_2^+ l_2^-$ at the LHC

(2004) *European Physical Journal C*, 32 (2), pp. 209-219. Cited 117 times.
doi: 10.1140/epjc/s2003-01392-0

View at Publisher

24 Godbole, R.M., Miller, D.J., Mühlleitner, M.M.
Aspects of CP violation in the HZZ coupling at the LHC

(2007) *Journal of High Energy Physics*, 2007 (12), art. no. 031. Cited 74 times.
doi: 10.1088/1126-6708/2007/12/031

View at Publisher

25 Hagiwara, K., Li, Q., Mawatari, K.
Jet angular correlation in vector-boson fusion processes at hadron colliders

(2009) *Journal of High Energy Physics*, 2009 (7), art. no. 101. Cited 68 times.
doi: 10.1088/1126-6708/2009/07/101

View at Publisher

26 Gao, Y., Gritsan, A.V., Guo, Z., Melnikov, K., Schulze, M., Tran, N.V.
Spin determination of single-produced resonances at hadron colliders

(2010) *Physical Review D - Particles, Fields, Gravitation and Cosmology*, 81 (7), art. no. 075022. Cited 192 times.
http://oai.aps.org/oai?verb=GetRecord&Identifier=oai:aps.org:PhysRevD.81.075022&metadataPrefix=oai_apsmeta_2
doi: 10.1103/PhysRevD.81.075022

View at Publisher

27 De Rújula, A., Lykken, J., Pierini, M., Rogan, C., Spiropulu, M.
Higgs boson look-alikes at the LHC

(2010) *Physical Review D - Particles, Fields, Gravitation and Cosmology*, 82 (1), art. no. 013003. Cited 104 times.
http://oai.aps.org/oai?verb=GetRecord&Identifier=oai:aps.org:PhysRevD.82.013003&metadataPrefix=oai_apsmeta_2
doi: 10.1103/PhysRevD.82.013003

View at Publisher

28 Christensen, N.D., Han, T., Li, Y.
Testing CP violation in ZZH interactions at the LHC

(2010) *Physics Letters, Section B: Nuclear, Elementary Particle and High-Energy Physics*, 693 (1), pp. 28-35. Cited 27 times.
doi: 10.1016/j.physletb.2010.08.008

View at Publisher

29 Bolognesi, S., Gao, Y., Gritsan, A.V., Melnikov, K., Schulze, M., Tran, N.V., Whitbeck, A.
Spin and parity of a single-produced resonance at the LHC

(2012) *Physical Review D - Particles, Fields, Gravitation and Cosmology*, 86 (9), art. no. 095031. Cited 129 times.
http://oai.aps.org/filefetch?identifier=10.1103/PhysRevD.86.095031&component=fulltext&description=markup&format=xml
doi: 10.1103/PhysRevD.86.095031

View at Publisher

30 Ellis, J., Hwang, D.S., Sanz, V., Youa, T.
A fast track towards the 'Higgs' spin and parity

(2012) *Journal of High Energy Physics*, 2012 (11), art. no. 134, pp. 1-16. Cited 19 times.
http://link.springer.com/journal/13130
doi: 10.1007/JHEP11(2012)134

View at Publisher

31 Chen, Y., Tran, N., Vega-Morales, R.
Scrutinizing the Higgs signal and background in the 2e2μ golden channel

(2013) *Journal of High Energy Physics*, 2013 (1), art. no. 182. Cited 23 times.
doi: 10.1007/JHEP01(2013)182

View at Publisher

32 Artoisenet, P., De Aquino, P., Demartin, F., Frederix, R., Frixione, S., Maltoni, F., Mandal, M.K., (...), Zaroi, M.
A framework for Higgs characterisation

(2013) *Journal of High Energy Physics*, 2013 (11). Cited 50 times.
doi: 10.1007/JHEP11(2013)043

View at Publisher

33 Anderson, I., Bolognesi, S., Caola, F., Gao, Y., Gritsan, A.V., Martin, C.B., Melnikov, K., (...), Zhou, Y.
Constraining anomalous H v V interactions at proton and lepton colliders

(2014) *Physical Review D - Particles, Fields, Gravitation and Cosmology*, 89 (3), art. no. 035007. Cited 54 times.
http://oai.aps.org/filefetch?identifier=PhysRevD.89.035007&component=fulltext&description=markup&format=xml
doi: 10.1103/PhysRevD.89.035007

View at Publisher

34 Chen, M., Cheng, T., Gainer, J.S., Korytov, A., Matchev, K.T., Milenovic, P., Mitselmakher, G., (...), Snowball, M.
Role of interference in unraveling the Z Z couplings of the newly discovered boson at the LHC

(2014) *Physical Review D - Particles, Fields, Gravitation and Cosmology*, 89 (3), art. no. 034002. Cited 23 times.
http://oai.aps.org/filefetch?identifier=PhysRevD.89.034002&component=fulltext&description=markup&format=xml
doi: 10.1103/PhysRevD.89.034002

View at Publisher

35 González-Alonso, M., Greljo, A., Isidori, G., Marzocca, D.
Pseudo-observables in Higgs decays

(2015) *European Physical Journal C*, 75 (3). Cited 19 times.
http://link.springer-ny.com/link/service/journals/10052/index.htm
doi: 10.1140/epjc/s10052-015-3345-5

View at Publisher

36 Greljo, A., Isidori, G., Lindert, J.M., Marzocca, D.
Pseudo-observables in electroweak Higgs production

(2016) *European Physical Journal C*, 76 (3), art. no. 158. Cited 9 times.
http://link.springer-ny.com/link/service/journals/10052/index.htm
doi: 10.1140/epjc/s10052-016-4000-5

View at Publisher

37 Landau, L.D.
On the angular momentum of a two-photon system
(1948) *Dokl. Akad. Nauk*, 60, p. 207. Cited 341 times.

38 Yang, C.N.
Selection rules for the dematerialization of a particle into two photons

(1950) *Physical Review*, 77 (2), pp. 242-245. Cited 638 times.
doi: 10.1103/PhysRev.77.242

View at Publisher

39 de Florian, D.
Handbook of LHC Higgs Cross Sections: 4. Deciphering the Nature of the Higgs Sector
(2016) . Cited 5 times.
Technical Report
http://arxiv.org/abs/1610.07922

40 Chatrchyan, S., Hmayakyan, G., Khachatryan, V., Sirunyan, A.M., Adam, W., Bauer, T., Bergauer, T., (...), Yuldashev, B.S.
The CMS experiment at the CERN LHC

(2008) *Journal of Instrumentation*, 3 (8), art. no. S08004. Cited 1229 times.
http://www.iop.org/EJ/journal/1748-0221
doi: 10.1088/1748-0221/3/08/S08004

View at Publisher

41 Gritsan, A.V., Röntsch, R., Schulze, M., Xiao, M.
Constraining anomalous Higgs boson couplings to the heavy-flavor fermions using matrix element techniques

(2016) *Physical Review D*, 94 (5), art. no. 055023. Cited 10 times.
http://harvest.aps.org/bagit/articles/10.1103/PhysRevD.94.055023/apsxml
doi: 10.1103/PhysRevD.94.055023

View at Publisher

42 Frixione, S., Nason, P., Oleari, C.
Matching NLO QCD computations with parton shower simulations: The POWHEG method

(2007) *Journal of High Energy Physics*, 2007 (11), art. no. 070. Cited 980 times.
doi: 10.1088/1126-6708/2007/11/070

View at Publisher

43 Bagnaschi, E., Degrassi, G., Slavich, P., Vicini, A.
Higgs production via gluon fusion in the POWHEG approach in the SM and in the MSSM

(2012) *Journal of High Energy Physics*, 2012 (2), art. no. 088. Cited 83 times.
doi: 10.1007/JHEP02(2012)088

View at Publisher

44 Nason, P., Oleari, C.
NLO Higgs boson production via vector-boson fusion matched with shower in POWHEG

(2010) *Journal of High Energy Physics*, 2010 (2), art. no. 037. Cited 106 times.
doi: 10.1007/JHEP02(2010)037

View at Publisher

45 Campbell, J.M., Ellis, R.K.
MCFM for the Tevatron and the LHC

(2010) *Nuclear Physics B - Proceedings Supplements*, 205-206 (C), pp. 10-15. Cited 326 times.
doi: 10.1016/j.nuclphysbps.2010.08.011

View at Publisher

46 Campbell, J.M., Ellis, R.K., Williams, C.
Vector boson pair production at the LHC

(2011) *Journal of High Energy Physics*, 2011 (7), art. no. 018. Cited 421 times.
doi: 10.1007/JHEP07(2011)018

View at Publisher

47 Campbell, J.M., Ellis, R.K., Williams, C.
Bounding the Higgs width at the LHC using full analytic results for gg → e $^{-}$ E $^{+}$ μ

(2014) *Journal of High Energy Physics*, 2014 (4), art. no. 060. Cited 71 times.
doi: 10.1007/JHEP04(2014)060

View at Publisher

48 Sirunyan, A.M., Tumasyan, A., Adam, W., Ambrogi, F., Asilar, E., Bergauer, T., Brandstetter, J., (...), Woods, N.
Measurements of properties of the Higgs boson decaying into the four-lepton final state in pp collisions at √s=13 TeV

(2017) *Journal of High Energy Physics*, 2017 (11), art. no. 47. Cited 5 times.
http://link.springer.com/journal/13130
doi: 10.1007/JHEP11(2017)047

View at Publisher

49 Khachatryan, V., Sirunyan, A.M., Tumasyan, A., Adam, W., Bergauer, T., Dragicevic, M., Erö, J., (...), Woods, N.
Constraints on the Higgs boson width from off-shell production and decay to Z-boson pairs

(2014) *Physics Letters, Section B: Nuclear, Elementary Particle and High-Energy Physics*, 736, pp. 64-85. Cited 91 times.
http://www.sciencedirect.com/science/journal/03702693
doi: 10.1016/j.physletb.2014.06.077

View at Publisher

50 Ballestrero, A., Belhouari, A., Bevilacqua, G., Kashkan, V., Maina, E.
PHANTOM: A Monte Carlo event generator for six parton final states at high energy colliders

(2009) *Computer Physics Communications*, 180 (3), pp. 401-417. Cited 27 times.
doi: 10.1016/j.cpc.2008.10.005

View at Publisher

51 Ball, R.D., Bertone, V., Cerutti, F., Del Debbio, L., Forte, S., Guffanti, A., Latorre, J.I., (...), Ubiali, M.
Unbiased global determination of parton distributions and their uncertainties at NNLO and at LO

(2012) *Nuclear Physics B*, 855 (2), pp. 153-221. Cited 121 times.
doi: 10.1016/j.nuclphysb.2011.09.024

View at Publisher

52 Sjöstrand, T., Ask, S., Christiansen, J.R., Corke, R., Desai, N., Ilten, P., Mrenna, S., (...), Skands, P.Z.
An introduction to PYTHIA 8.2

(2015) *Computer Physics Communications*, 191 (1), pp. 159-177. Cited 384 times.
http://www.elsevier.com/wps/find/journaldescription.cws_home/706710/description#description
doi: 10.1016/j.cpc.2015.01.024

View at Publisher

53 Khachatryan, V., Sirunyan, A.M., Tumasyan, A., Adam, W., Asilar, E., Bergauer, T., Brandstetter, J., (...), Woods, N.
Event generator tunes obtained from underlying event and multiparton scattering measurements

(2016) *European Physical Journal C*, 76 (3), art. no. 155. Cited 86 times.
http://link.springer-ny.com/link/service/journals/10052/index.htm
doi: 10.1140/epjc/s10052-016-3988-x

View at Publisher

54 Agostinelli, S., Allison, J., Amako, K., Apostolakis, J., Araujo, H., Arce, P., Asai, M., (...), Zschiesche, D.
GEANT4 - A simulation toolkit

(2003) *Nuclear Instruments and Methods in Physics Research, Section A: Accelerators, Spectrometers, Detectors and Associated Equipment*, 506 (3), pp. 250-303. Cited 9912 times.
doi: 10.1016/S0168-9002(03)01368-8

View at Publisher

55 Sirunyan, A.M., Tumasyan, A., Adam, W., Asilar, E., Bergauer, T., Brandstetter, J., Brondolin, E., (...), Woods, N.
Particle-flow reconstruction and global event description with the CMS detector

(2017) *Journal of Instrumentation*, 12 (10), art. no. P10003. Cited 16 times.
http://iopscience.iop.org/article/10.1088/1748-0221/12/10/P10003/pdf
doi: 10.1088/1748-0221/12/10/P10003

View at Publisher

56 Cacciari, M., Salam, G.P., Soyez, G.
The anti-k $_t$ jet clustering algorithm

(2008) *Journal of High Energy Physics*, 2008 (4), art. no. 063. Cited 2310 times.
doi: 10.1088/1126-6708/2008/04/063

View at Publisher

57 Cacciari, M., Salam, G.P., Soyez, G.
FastJet user manual: (For version 3.0.2)

(2012) *European Physical Journal C*, 72 (3), art. no. 1896, pp. 1-54. Cited 792 times.
http://link.springer-ny.com/link/service/journals/10052/index.htm
doi: 10.1140/epjc/s10052-012-1896-2

View at Publisher

58 Neyman, J., Pearson, E.S.
On the problem of the most efficient tests of statistical hypotheses
(1933) *Philos. Trans. R. Soc. Lond. A, Math. Phys. Eng. Sci.*, 231, p. 289. Cited 1052 times.